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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	ET Docket 93-62
Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation	)	
	)	

Comments of Hatfield & Dawson Consulting Engineers, Inc.

INTRODUCTION

These comments address the categories outlined the March 11, 1993 Notice Of Proposed Rule Making with some additional categories that are matters of concern. Because of the complexities of the issues involved it is not possible to make specific recommendations for all of the questions raised by the proposal to adopt ANSI/IEEE C95.1-1992. What follows constitutes a general outline of our thinking based upon twenty years of experience as a professional engineering corporation and considerable experience in the prediction and measurement of electromagnetic fields.

Definition of "Controlled" and "Uncontrolled" Environment

Are all workplace situations Controlled Environments? Implicit in the Controlled Environment definition is the concept of informed consent. The Controlled Environment is an environment where knowledge of the potential hazard somehow confers protection against exposure to higher fields. If a person is exposed to electromagnetic fields at their place of work for extended periods of time in a Controlled Environment the impact of their state of mind (i.e. they are "..aware of the potential for exposure...") upon the potential biological effect of that exposure can only be described as metaphysical. When the exposure is unavoidable for periods of time longer than

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the averaging time specified in the standard and the exposed workers have been informed of the hazard it is implied in the definition of the Controlled Environment that their consent has been given for higher electromagnetic field exposure than that received by the general public as a condition of employment. The difference in allowable exposures for different classes of individuals could lead to "Contributory Negligence" actions at law whether or not such exposures are actually harmful.

These and other inconsistencies in the definition of the Controlled and Uncontrolled Environments require clarification. Further questions arise: Does notification change an Uncontrolled Environment into an Controlled Environment? Must individuals in Controlled Environments be trained in the electromagnetic art?

Measurement Procedures and Related Issues

The calculations shown in OST 65 regarding the fields from AM towers are not correct. Repeated measurements and moment method computations have demonstrated that they exaggerate the magnetic and electric near field intensities in the vicinity of AM towers. Computer modelling to determine to determine a more accurate depiction of RF exposure from AM towers must be performed carefully, however, and benchmarked with measured data.

The method shown in Gailey and Tell in their 1985 EPA report gives a more accurate assessment of the RF exposure situation at FM and TV transmission sites than that shown in the simplified charts and graphs of OST 65. Consultants are frequently employed, at some expense to licensees, to perform measurements in situations where OST 65 has shown that the standard has been exceeded but the EPA methodology has shown that they are not exceeded. It can be shown that in every case the measurements agree more closely with the EPA prediction method. More general use of the EPA equation (shown in OST 65) and the measured vertical antenna patterns would save both time and money. Great care must be employed in the use of vertical antenna patterns for side mounted antennas. The scattering effects of the tower can be computed through use of moment methods but they must be benchmarked by measurements.

In the absence of such computations measured vertical patterns with the antenna mounted on a tower section provide the only realistic means for assessing the exposure environment.

The C95.1-1992 standard is based upon the Specific Absorption Rate (SAR) of the exposed individual and the SAR is proportional to the incident power density. Available meters do not measure power density but instead measure the electric or magnetic field contribution to power density for the situation where the electromagnetic field is propagated as a plane wave and the ratio of the electric and magnetic field is equal to the impedance of free space. This is not an accurate assumption in many near field measurement situations or where there is a highly reflective environment. An instrument such as that described in a paper given at the August 1993 IEEE International EMC Symposium could resolve this situation [1]. This paper describes the implementation of a concept originated by Motohisa Kanda in 1984 for the measurement of actual power density. In the conclusion of the paper it is stated that a device could be designed for measurements over a frequency range from 75 KHz to 1.2 GHz.

[1] "AN ISOTROPIC BROADBAND ELECTRIC AND MAGNETIC FIELD SENSOR FOR RADIATION HAZARD MEASUREMENTS", F. Gassman, J. Furrer, pp. 105-108, IEEE 1993 International Symposium on Electromagnetic Compatibility, Symposium Record, August 9-13, 1993, The Grand Kempinski, Dallas, Texas.

Induced and Contact RF Currents

CONTACT CURRENTS

Grasping contact current limits are specified in C95.1-1992 for frequencies below 100MHz. For exposure from broadcast installations the circumstances are different for the various broadcast services: AM medium wave transmitter sites; HF transmission sites; VHF FM and TV transmission facilities.

In reality the only measurable contact currents caused by AM fields result from touching large objects that are reasonably efficient antennas. Cranes, power poles and other metallic structures on the order of one hundred feet in height are the major sources of measurable contact currents. Numerous measurements have shown that fences, flag poles and other conducting objects more than a quarter wavelength away from AM antennas or arrays do not present a contact current hazard. Determination of the hazard potential of these objects, and whether contact currents should be measured, can usually be determined by electric and magnetic field measurements.

HF facilities present a more complicated contact current environment. Guy wires associated with HF antennas with transmitter output powers in the 5KW to 10 KW range often are sources of contact current above the 100 mA Maximum Permissible Exposure (MPE). As a result contact currents should be routinely measured at all HF facilities.

Contact currents can be a real problem at VHF TV & FM sites. Any metallic fence, pole, guy wire, etc. will probably exhibit measurable contact current. However, there is as yet no commercial instrument available to measure contact currents at 100 MHZ. To measure contact currents a method developed by Ric Tell can be used. A VHF field strength meter used as a two terminal volt meter (such as the Potomac Industries model FIM-71), a six inch copper tube, and a current transformer can be used to measure contact currents one frequency at a time. A great many contact current measurements are necessary at a typical FM or TV transmission site to demonstrate compliance with ANSI C95.1-1992.

The extension of the contact current requirement to 100 MHZ by C95.1-1992 has placed the Commission on the horns of a dilemma. There is no contact current standard for VHF facilities over 100 MHz. There is limited research on contact current effects much above the lower portion of the VHF band of frequencies, and the requirement at 100 MHz must be recognized as an extrapolation. If the Commission adopts the C95.1 standard for contact currents as it stands, measurements would not be required for those FM stations above 100 MHZ. This would be an absurd requirement! To extend the contact current MPE to the upper end of the FM band, or to exempt the entire FM band from the contact current requirement would mean making scientific judgements that the Commission has in the past refused to make because of lack of expertise. This issue can only be resolved by involving in the process those experts who have performed, or have intimate knowledge of, the contact current effects research.

INDUCED CURRENTS

C95.1-1992 specifies limits on the current flowing through the feet of a free standing individual who is not in contact with metallic objects. The induced currents are caused by a person acting as a monopole over an imperfectly conducting ground plane. The concern prompting this new induced current standard is that one could receive an RF burn on the bottoms of his feet or exceed the maximum allowed specific absorption rate in his ankles. Experience has shown that it is mainly at high power HF sites that induced currents exceed the 100 mA per foot MPE shown in C95.1-1992. The standard is based upon research that was performed using far field plane wave exposure situations on barefooted subjects. Neither of these assumptions are realistic in "Controlled Environments". Most workers are in the "Near Field" and wear shoes. For these reasons the induced current requirements are excessively "worst case". While numerous cases of RF burns from excessive contact currents have been reported near AM broadcast transmission facilities there, are no reports of foot burns caused by induced currents. Field measurements of induced currents at AM, FM and TV transmission facilities could resolve the apparent contradiction between the data based upon laboratory experiments and the practical experience of broadcast engineers.

The thrust of the induced current MPE appears misguided. The electric and magnetic field exposure MPE is based upon the specific absorption rate. The specific absorption rate (SAR) is a measure of the heating caused by currents flowing in the body. Measuring the induced foot currents in addition to electric and magnetic field measurements is therefore redundant in that the effects of local SARs in the feet are, or should be, a part of the existing field exposure standard.

ELECTRIC AND MAGNETIC FIELD EXPOSURE LIMITS

The C95.1-1992 electric and magnetic field maximum permissible exposure limits are not consistent in their application to medium frequency (MF) and VHF broadcast services. The "Uncontrolled Environment" electric field MPE is fixed at 614 Volts per meter (V/m) for frequencies up to 1340 kHz in the AM band and ramps downward as a function of frequency above this point while the ramp for "Controlled Environment" electric fields begins at 3.0 MHz. The implication is that AM stations operating at frequencies above 1340 kHz are somehow creating a greater human exposure hazard for "Uncontrolled Environments" than for "Controlled Environments". In the FM band a break in the standard occurs at 100 MHz. In addition, power density is emphasized above 100 Mhz but not below 100 MHz. Experts in the field should assist the Commission in resolving these inconsistencies.

CONCLUSION

While the new ANSI/IEEE C95.1-1992 standard represents a significant advance over C95.1-1982 in the understanding of electromagnetic effects it cannot be applied wholecloth to the needs of FCC licensees. Expert help is required to adapt C95.1-1992 to be fairly applied to all users of Radio Frequency energy. Inconsistencies in "Controlled Environment" and "Uncontrolled Environment" definitions, application of appropriate frequency bounds to contact measurements, and the breakpoints in the electric field, magnetic field and power density MPEs must be resolved. More measurements are necessary to properly determine the impact of induced body currents upon the standard and whether such effects are not already covered in the field exposure MPEs. And finally, new instruments must be made available to (1) measure contact currents over a wide range of frequencies from MF to VHF and (2) resolve the near field dilemma through the direct measurement of power density.

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